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Modeling of series and parallel solar cell tandems ALEXANDER KUZNETSOV, ANVAR ZAKHIDOV, Nanotech Institute, University of Texas at Dallas — Significant improvement of the solar cell efficiency is achieved by combining solar cells into tandems. Circuit analysis allows us to determine tandem parameters that guarantee its most efficient operation. In this study we apply the single-diode model to the analysis of solar cells connected in series and in parallel. The model explains how tandem efficiency relates to the efficiency of individual cells and suggests different ways of efficiency improvement in the series and parallel configurations. Thus, we predict that a parallel tandem shows highest efficiency when open circuit voltages of its individual cells are equal to each other. In a series configuration, short circuit currents and fill factors must be matched to achieve best device performance. If the parameters of individual solar cells remain unmatched, parallel connection usually results in higher tandem efficiency. We also analyze experimental results for several types of organic solar cells and explain the efficiency drop observed in tandems compared to the combined efficiency of the individual cells.

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